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*formal und inhaltlich überarbeitete Version der Originalveröffentlichung in:*

*formally and content revised edition of the original source in:*

*Psychology and aging 31 (2016) 5, S. 532-544*



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urn:nbn:de:0111-pedocs-165921

10.25656/01:16592

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<https://doi.org/10.25656/01:16592>

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# **Anxiety in Late Adulthood – Associations with Gender, Education, and Physical and Cognitive Functioning**

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*Supplemental materials:* <http://dx.doi.org/10.1037/pag0000108.supp>

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This article version has been accepted for publication in **Psychology and Aging** and undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process, which may lead to differences between this version and the published version. The final, definitive version of this paper has been published in:

Tetzner, J., & Schuth, M. (2016, May 30). Anxiety in Late Adulthood: Associations with Gender, Education, and Physical and Cognitive Functioning. *Psychology and Aging*, 31, 532-544. <http://dx.doi.org/10.1037/pag0000108>

*Acknowledgements:*

This paper uses data from SHARE Wave 5 Release 1.0.0, as of March 31, 2015 (DOI: 10.6103/SHARE.w5.100), and SHARE Wave 4 Release 1.1.1, as of March 28, 2013 (DOI: 10.6103/SHARE.w4.111). The SHARE data collection has been primarily funded by the European Commission through the Fifth Framework Programme (Project QLK6-CT-2001-00360 in the thematic programme Quality of Life), through the Sixth Framework Programme (projects SHARE-I3, RII-CT-2006-062193; COMPARE, CIT5-CT-2005-028857; and SHARELIFE, CIT4-CT-2006-028812) and through the Seventh Framework Programme (SHARE-PREP, Number 211909; SHARE-LEAP, Number 227822; and SHARE M4, Number 261982). Additional funding from the U.S. National Institute on Aging (U01 AG09740-13S2, P01 AG005842, P01 AG08291, P30 AG12815, R21 AG025169, Y1-AG-4553-01, IAG BSR06-11 and OGHA 04-064) and the German Ministry of Education and Research, as well as from various national sources, is gratefully acknowledged (see [www.share-project.org](http://www.share-project.org) for a full list of funding institutions).

**Abstract**

Anxiety is common in late adulthood and can complicate adjustment in several areas. This study used data from two measurement points of a representative European longitudinal study (SHARE) with a large sample size ( $N = 28,326$ ) and a broad age range (45-90) to examine age effects on cross-sectional mean levels of anxiety as well as longitudinal mean-level changes over two years with respect to gender, education, and changes in physical and cognitive functioning. Furthermore, we analyzed generalizability of the findings for different European countries. Latent change models and locally weighted smoothing curves revealed three main findings: (1) Mean levels of anxiety were relatively stable over the course of middle adulthood and increased during late adulthood; (2) Women and individuals with less education were more anxious than men and individuals with more education; and (3) Increases in anxiety in late adulthood were associated with age-associated losses in physical and cognitive functioning.

*Keywords:* anxiety, late adulthood, latent change models, locally weighted smoothing curves, physical and cognitive functioning

Anxiety is common in late adulthood (Blay & Marinho, 2012) and a major concern on several levels: It impairs quality of life (Beurs, Beekman, Deeg, van Dyck, & van Tilburg, 2000), is likely to expand to further mental disorders (Wetherell, Gatz, & Pedersen, 2001), and involves high economic costs (Olesen, Gustavsson, Svensson, Wittchen, & Jönsson, 2012). Hence, understanding the development of anxiety in older adults has widespread significance. To this end, developmental theories suggest that it may be useful to take age-associated declines in functioning into account: They assert that aging is accompanied with losses in several life domains (Baltes, 1997), and coping with them may promote anxiety (Clark & Beck, 2010) and, thus, contribute to the association between age and anxiety. However, longitudinal research on anxiety and aging with large representative samples remains rare. This study aimed to address this gap by using a European longitudinal study with a large sample size and a broad age range. We examined developmental trajectories of anxiety from middle to late adulthood with an additional focus on gender and educational differences. To address the contribution of age-associated losses, we examined associations to indicators of physical and cognitive functioning with respect to their influences on age differences in anxiety.

### **Anxiety and Age**

The majority of previous research has focused on clinically relevant anxiety disorders and mainly concluded that anxiety is relatively common in late adulthood. Epidemiological studies estimate prevalence rates in late adulthood between 3.2 and 14.2 percent (Wolitzky-Taylor, Castriotta, Lenze, Stanley, & Craske, 2010) and mainly indicate decreasing prevalence in older adults (Blay & Marinho, 2012; Byers, Yaffe, Covinsky, Friedman, & Bruce, 2010; Wolitzky-Taylor et al., 2010). Beyond clinical research, only a few studies have addressed anxiety by taking subthreshold symptoms into account or considering anxiety as a continuous trait; these studies have produced an inconclusive pattern of results. Lawton and

colleagues (Lawton, Kleban, & Dean, 1993) compared anxiety self-reports cross-sectionally across age groups and found lower anxiety in older adults. Using a large cross-sectional German data set with two age groups (70-84 years, 85-103 years), Schaub and Linden (2000) found lower rates of anxiety disorders in the older group but no age differences in the amount of anxiety symptoms. In a more recent cross-sectional study with American adults, Teachman (2006) found a cubic association with age: a slight age-related decrease through middle adulthood and increases in late adulthood that started around the age of 75.

Previous longitudinal studies also have not clarified the inconsistent pattern of results. Martin and colleagues (Martin, Long, & Poon, 2002) drew on an American two-wave study with sexagenarians, octogenarians, and centenarians. Even if anxiety seemed to increase in older adults (cross-sectionally and longitudinally) on a descriptive level, they found no statistically significant age differences. By analyzing a larger Dutch sample of 55-85 year-olds, De Beurs and colleagues (2000) found results indicating a slight statistically significant increase in anxiety over a period of three years. Given the inconsistency of these few previous results, much more research is needed to clarify the course of anxiety in late adulthood.

The majority of previous studies also had substantial limitations that reduced their contributions. Most used cross-sectional samples and must therefore be considered with caution. On the one hand, two meta-analyses (Twenge, 2000) provided evidence for a cohort effect so that anxiety shifted toward higher mean levels across the last half of the twentieth century. On the other hand, selection issues must be taken into account. Given that mental health is associated with mortality, the people who have survived to 80 or 90 may be those who manage stress and anxiety better than the average person (who would still be captured in a sample of younger people). In addition, previous research has usually used relatively small samples and relatively large age ranges. In consequence, people of different ages were often

summarized into age groups, which resulted in a reduction of variability and impaired explanatory power. To address the relation between anxiety and age in an appropriate manner, longitudinal studies with large representative samples and broad age ranges are essential.

Several psychological theories offer ideas about why anxiety may change in late adulthood. The life span theory of development (Baltes, 1997; Baltes & Baltes, 1990) provides a meta-theoretical framework in which to embed more specific theories that can help to explain age-associated changes. Baltes and colleagues therefore understand human development as a ratio between gains and losses that shifts from childhood to late adulthood. They propose that the second half of life is characterized by age-associated declines in several life domains, for example, increasing impairments in functional status (e.g., Smith & Baltes, 1997) and decreasing autonomy and increasing dependency (e.g., Baltes, 1995). Building on this, cognitive models of anxiety (Beck, Emery, & Greenberg, 1985; Clark & Beck, 2010) suggest that frequent confrontations with losses should lead to higher levels of anxiety by activating existing dysfunctional cognitions and maladaptive schematic representations that further lead to an increased number of negative and threat-related thoughts. Following these assumptions, we would expect to find increasing levels of anxiety in late adulthood caused by age-associated losses.

To complement this view on aging, Baltes and colleagues (e.g., Baltes, 1997) furthermore describe three fundamental developmental components, namely selection, optimization, and compensation, that can help people to maintain functioning and to regulate and manage losses in late adulthood. The socioemotional selectivity theory (SST; Carstensen, 2006; Carstensen, Isaacowitz, & Charles, 1999; Carstensen & Mikels, 2005) matches this view and provides an explanation for how older people may use selection strategies to prevent increases in anxiety. SST posits that people change their motivational priorities when



they perceive limitations on remaining time – as is typically the case in late adulthood. They prioritize emotionally meaningful goals and emphasize the maintenance of positive emotionality (*positivity effect*, e.g., Mather & Carstensen, 2005; *affect optimization* in Labouvie-Vief, Diehl, Jain, & Zhang, 2007). For instance, research has indicated that positive cues, in contrast to negative cues, are associated with relatively better memory function and greater neural activations in older people (Mather et al., 2004); that older adults tend to perceive many anxiety triggers as less threatening than do younger adults (Teachman & Gordon, 2009); and that older adults show more positive well-being and greater emotional stability (Carstensen et al., 2011). As a consequence, these motivational shifts may improve emotion regulation in late adulthood (Carstensen & Mikels, 2005; see also Urry & Gross, 2010) and should therefore prevent older people from experiencing increases in anxiety.

### **Gender Differences and Anxiety**

It is a commonly found result that women report more anxiety than men (e.g., Beurs et al., 2000). Epidemiological studies indicate that women are almost twice as likely to develop anxiety disorders (e.g., McLean, Asnaani, Litz, & Hofmann, 2011). Previous research has shown that gender differences begin to emerge at the age at which socialization factors also begin to exert their influences (McLean & Anderson, 2009). Researchers therefore hypothesize that gender differences are mainly caused by gender-specific expectations regarding expressing and coping with threat and anxiety.

### **Educational Differences and Anxiety**

It is also well-documented that anxiety and anxiety disorders are related to lower socioeconomic status and lower levels of education (e.g., Regier, Narrow, & Rae, 1990; Teachman, 2006). To explain this association, previous research has discussed mechanisms of selection (i.e., anxiety can impair socioeconomic attainment) and socialization (i.e.,

socioeconomic disadvantages can increase subsequent anxiety; Mossakowski, 2014).

Researchers have especially emphasized the importance of social causation processes as class-related social conditions (Miech, Caspi, Moffitt, Wright, Entner, & Silva, 1999).

### **Anxiety and Age-associated Losses**

The abovementioned theories suggest that it may be useful to take age-associated losses into account when explaining the association between age and anxiety. Cognitive models (e.g., Clark & Beck, 2010) indicate that age-associated losses should lead to more anxiety. In contrast, SST (e.g., Carstensen, 2006) proposes that older people use advanced emotion regulation strategies to cope with these losses and head off increases in anxiety. The two approaches differ in their assumptions about underlying mechanisms, but both suggest that the association between age and anxiety may change considerably as a function of declines in various domains of functioning.

Empirical research has confirmed that late adulthood is strongly associated with losses in psychological, social, and biological domains, such as declines in cognitive and physical functioning or feelings of decreasing autonomy and increasing dependency (e.g., Hartshorne & Germine, 2015; Salthouse, 2004; Smith & Baltes, 1997). Numerous studies have moreover proved cross-sectional associations between anxiety and declines in these domains. For example, research has identified associations between anxiety and low levels of perceived control (Gallagher, Bentley, & Barlow, 2014) and higher levels of perceived dependency (Persons, Burns, Perloff, Miranda, 1993) or cognitive and physical impairment (Lenze et al., 2001; Yochim, Mueller, & Segal, 2013). However, only a few longitudinal studies have tested the directionality of these effects. Findings indicated that cognitive or physiological declines can predict anxiety symptoms but also gave hints that the reversed relation could be true (Beaudreau & O'Hara, 2008; Lenze et al., 2001). For instance, De Beurs and colleagues (2000) used a Dutch sample in late adulthood to find hearing and eyesight problems

associated with becoming anxious three years later. Although the scarce body of previous research does not clearly uncover the longitudinal directionality of associations between anxiety and losses in functioning, mutual associations may complicate the comparison of anxiety between age groups that differ in their levels of functioning (see Teachman, 2006).

### **The present study**

The current study aimed to extend the scarce previous research on anxiety and aging by examining developmental trajectories of anxiety in a non-clinical sample in late adulthood with respect to gender, education, and changes in physical and cognitive functioning. In contrast to most previous studies, ours focused on anxiety as a dimensional rather than a categorical construct, meaning that we considered anxiety as falling and rising on a continuum rather than being defined by qualitatively distinct categories. This procedure allowed us to differentiate variations in levels and changes in anxiety that did not meet the criteria for anxiety disorders but that have been shown to predict well-being and to increase the probability of future anxiety disorders (for a discussion, see Schaub & Linden, 2000; Teachman, 2006). Using a large representative European sample enabled us to detect even small changes and interactions and to generalize our findings to a wider population. The longitudinal design and the large age range allowed us to compare cross-sectional and longitudinal findings: We analyzed interindividual age differences in mean levels as well as age effects in intraindividual mean-level changes. Our hypotheses can be summarized as follows:

First, we expected to find a non-linear relationship between age and anxiety. More precisely, we assumed mean-level stability in anxiety in middle adulthood followed by slight increases in late adulthood. We based this assumption on the few longitudinal findings in Europe (Beurs et al., 2000) that have indicated increases in anxiety in late adulthood and on theoretical considerations of cognitive models of anxiety (e.g., Beck et al., 1985) that suggest

that age-associated losses should increase threat-related thoughts and thereby promote anxiety. As Social Selectivity Theory (SST; e.g., Carstensen, 2006) posits that older people use emotion regulation strategies to maintain well-being in the face of losses, we expected to find only slight increases in anxiety in late adulthood. Since previous research has indicated the presence of cohort effects (Twenge, 2000), cross-sectional age-differences may be biased by an overall increase in anxiety during the last half of the 20<sup>th</sup> century. We therefore primarily expected to find age-graded increases in anxiety in our longitudinal results.

Second, drawing on a large body of previous findings (e.g., McLean et al., 2011; Teachman, 2006), we expected to find gender and educational differences in anxiety so that women and less educated adults should report higher levels of anxiety. We also explored differences in longitudinal trajectories of anxiety as a function of gender and education.

Third, working from the assumption that the examination of declines in physical and cognitive functioning (i.e., developmental changes and losses in older adults; see Baltes, 1987) could make an important contribution to the understanding of developmental changes in anxiety in late adulthood, we drew on cognitive theories (e.g., Clark & Beck, 2010) and previous findings (e.g., Beaudreau & O'Hara, 2008), expecting to find declines in functioning associated with increases in anxiety. Since we mainly expected increases in anxiety in late adulthood to result from higher frequencies of losses, we anticipated that the statistical consideration of the relation between anxiety and physical and cognitive functioning would reduce the expected positive association between age and anxiety.

## **Method**

### **Participants**

We used the Survey of Health, Ageing and Retirement in Europe (SHARE), a large multidisciplinary, representative, biennially-conducted longitudinal study of the European

population aged 50 and older (see Börsch-Supan & Jürges, 2005 for details). Since anxiety was not measured in the first three waves of SHARE, we used the fourth and the fifth waves for our analyses. The first wave of SHARE occurred in 2004 with 30,000 respondents in eleven European countries. Additional countries participated in subsequent waves.<sup>1</sup> The target population of SHARE consisted of all households with at least one member aged 50 or older who spoke the official language of the country and did not live abroad or in an institution. In countries with registers of individuals, households were initially chosen using a multistage random sampling technique with regional clustering. In countries without access to individual registers, the survey sampling design comprised single or multi-stage sampling using telephone directories, followed by screening in the field. In wave 4 and wave 5, one age-eligible person and his/her partner/spouse was interviewed in the household. In all waves of SHARE, participants were personally interviewed through Computer Assisted Personal Interview techniques. To avoid attrition, the respondents received a letter before the interview with a brochure containing some results of the data surveyed before. Overall, the mean stability of the panel between the fourth (2010/11;  $N = 58,489$ ) and fifth waves (2013;  $N = 65,281$ ) was above 76.2 percent on the individual level (76.8 percent on the household level).

For our analyses, we included individuals with data on anxiety at both measurement points (2010/11 and 2013). Attrition analyses revealed slight selection effects on gender and anxiety level. Specifically, continuers were more likely to be female ( $d = 0.04$ ;  $p < .001$ ) and to report less anxiety ( $d = 0.28$ ;  $p < .001$ ) but showed no differences in age ( $d = 0.02$ ) or education ( $d = 0.02$ ). Because of small sample sizes for younger as well as very old respondents, we restricted our analyses to participants (i.e., target persons and their partners) not younger than age 45 and not older than age 90. Our final sample comprised  $N = 28,326$

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<sup>1</sup> Over the years, SHARE has added refreshment samples for selected countries. For instance, in 2013, about 4500 respondents joined the German SHARE subsample.

individuals (female = 56.9 percent) from twelve European countries (Denmark, Sweden, Austria, France, Germany, Switzerland, Belgium, Netherlands, Spain, Italy, Czech Republic, Slovenia) with a mean age of 65.60 years ( $SD = 9.56$ ) at the first measurement point.

### Instruments

*Anxiety.* Anxiety was assessed biennially with five items chosen from the Beck Anxiety Inventory (BAI; Beck, Epstein, Brown, & Steer, 1988; Wetherell & Areán, 1997). Although somatic symptoms of anxiety were overrepresented in the 21-item original scale (Kabacoff, Segal, Hersen, Van Hasselt, 1997), SHARE used three items of the cognitive (“I had fear of the worst happening”, “I was nervous”, “I had a fear of dying”) and two items of the somatic subscale (“I felt my hands trembling”, “I felt faint”) on a four-point Likert scale (1 = *never*, 2 = *hardly ever*, 3 = *some of the time*, 4 = *most of the time*).<sup>23</sup> The reliabilities were reasonable with  $\alpha_{t1} = .68$  and  $\alpha_{t2} = .69$ . The correlation with depression (as measured by the European Depression [EURO-D] scale, Prince et al., 1999) was comparable to previously reported discriminant validities with the full scale ( $r = .56$ ;  $p < .001$ ).

*Education.* Education was coded using the International Standard Classification of Education (ISCED) framework, which was designed to facilitate comparisons of education statistics and indicators across countries (see UNESCO, 2012 for more details). In wave 4,

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<sup>2</sup> Since it was argued that the somatic items of the BAI may measure medical comorbidity rather than anxiety symptoms in older adults (Wetherell & Gaz, 2005), we ran additional analyses that included the three cognitive items and excluded the two somatic items. The results can be found in tables S.3 and S.4 in the supplemental material.

<sup>3</sup> As a clinical screening tool, the BAI provides cut-off scores estimating the severity of anxiety (Beck & Steer, 1993): A score of 26-63 points on the original 21-item scale indicates severe (clinically relevant) anxiety symptoms. Although we have no valid cut-off scores for our five items, we converted these values to get an idea of the distribution of anxiety in our sample. Building on this, 8.7 percent of our sample reported severe anxiety symptoms at t1 and 10.3 percent at t2. Nevertheless, this categorization must be interpreted with caution.

the ISCED 1997 revision was used to code the education variables in seven ordinal categories (Level 0 = pre-primary education, Level 1 = primary education, Level 2 = secondary education first stage, Level 3 = upper secondary education, Level 4 = post-secondary non-tertiary education, Level 5 = first stage of tertiary education, Level 6 = second stage of tertiary education).

*Losses in functioning.* Previous research associated older adulthood with declines in functional status, i.e., increasing impairments in physical and cognitive function and feelings of decreasing autonomy and increasing dependency. We used a range of objective and subjective measures to address losses in participants' functional status.

To operationalize physical and cognitive impairments, we used four indicators that match areas of cognitive and physical functioning. First, we combined three indicators that mainly represent cognitive functioning: numeracy and numeric ability, verbal fluency, and verbal memory (for a detailed description, see Folstein, Folstein, & McHugh, 1975; Ofstedal, Fisher, & Herzog, 2005). Reliabilities of the combined score were reasonable with  $\alpha_{t1} = .94$  and  $\alpha_{t2} = .94$ . Numeracy and numeric ability was measured by a clinical test in which the respondent subtracts increments of seven starting with one hundred minus seven (serial sevens test). Verbal fluency was measured by a single item that counts the number of different animals the respondent can name in one minute (ranging from 0 to 100). Verbal memory was measured via a recall test in which the interviewer reads a list of ten common words and the respondent recalls as many words as possible in any order. The first recall follows immediately; the delayed recall is conducted later in the interview. To avoid learning effects, respondents were assigned randomly to one of four different "ten words" lists. We combined the measurements from the first test and the delayed recall test into a single item that ranges from 0 to 20.

Second, we used the self-perceived degree of physical activity as an indicator for physical functioning. This measure was based on one item that asks for the frequency of vigorous physical activity (1 = *hardly ever, or never*, 2 = *one to three times a month*, 3 = *once a week*, 4 = *more than once a week*).

Third, we used the global activity limitation index (GALI; Jagger et al., 2010) to measure self-perceived limitations on activities. In using this indicator, we assumed that it mainly represents declines in physical functioning. However, this measure may also capture declines in cognitive functioning and feelings of decreasing autonomy and control. Jagger and colleagues (2010) showed that GALI reflects levels of function and disability satisfactorily by assessing long-standing objective and subjective measures, both across and between countries. The GALI in the SHARE survey was based on the following question: “For the past six months at least, to what extent have you been limited because of a health problem in activities people usually do?” (1 = *severely limited*, 2 = *limited, but not severely*, 3 = *not limited*). Answers of 1 or 2 were combined into one category, resulting in a dichotomized GALI indicator (0 = *no limitations*, 1 = *limitation*).

Finally, autonomy and control in old age was measured by a subscale of the CASP-12 scale (C=control, A=autonomy, S=self-realisation, P=pleasure; Knesebeck, Hyde, Higgs, Kupfer, & Siegrist, 2005; a reduced version of the CASP-19 scale developed by Hyde, 2003). It has been shown that CASP-12 is highly correlated with CASP-19 (Knesebeck et al., 2005). The six items (“How often do you think your age prevents you from doing the things you would like to do?”, “How often do you feel that what happens to you is out of your control?”, “How often do you feel left out of things?”, “How often do you think that you can do the things that you want to do?”, “How often do you think that family responsibilities prevent you from doing what you want to do?”, and “How often do you think that shortage of money stops you from doing the things you want to do?”) were measured on a four-point Likert scale



(1 = *often*, 2 = *sometimes*, 3 = *rarely*, 4 = *never*) and recoded so that higher scores represented higher autonomy and control. The reliabilities were reasonable with  $\alpha_{t1} = .64$  and  $\alpha_{t2} = .65$ .

### **Analytical Strategy**

We used latent change models for analyzing mean-level changes in anxiety over the course of middle and late adulthood. We additionally estimated locally weighted smoothing curves (LOESS curves) to test for nonlinearity of developmental trajectories in anxiety across adulthood. For this, we used the R 2.15.1 software (R Core Team, 2014).

We used the software package *Mplus* 7.1 (Muthén & Muthén, 1998-2012) for structural equation modeling. We used the full information maximum-likelihood (FIML) estimation method to account for missing data on single items.<sup>4</sup> All models used latent factors stepwise tested for measurement invariance. This procedure allowed us to investigate structural relationships independent of either random measurement error or longitudinal changes in the reliabilities of constructs (Bollen & Curran, 2006). As the SHARE data had a multilevel structure with individuals nested in households, there may be dependencies in our data resulting from similarities in our variables within selected households. To account for the hierarchical data structure, we estimated the models with robust standard errors with the analysis option type = complex (using household as cluster variable). We evaluated the fit of our models using multiple model fit indices: the root mean square error of approximation (RMSEA), the comparative fit index (CFI), and the standardized root mean square residual

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<sup>4</sup> Since the attrition analyses revealed an association between anxiety and attrition, we cannot rule out that this association may bias our findings. We therefore conducted additional analyses that used FIML to account for attrition at t2, including all participants with data on anxiety at t1 ( $N = 58489$ ). This alternative approach produced the same pattern of results.

(SRMR). CFIs above .90 and RMSEAs and SRMRs below .08 typically indicate an acceptable fit to the data (Schermelleh-Engel, Moosbrugger, & Müller, 2003).

*Measurement invariance model.* As a basis for all further analyses, we specified a structural model across all measurement points with one latent factor for each point and progressively tested it for measurement invariance. As anxiety was measured with five items at both measurement points, each latent factor was built using five manifest indicators. Since we can assume strict factorial invariances across time (as factor loadings, measurement intercepts and residual variances were constrained to be equal across time points; see Meredith, 1993), our results are independent of changes in measurement across time (see Table 1). By the same token, we allowed for correlated residuals of the corresponding manifest items across adjacent time points (Bollen & Curran, 2006).

*Latent change models.* We used latent change models to investigate mean-level changes in anxiety (see McArdle & Hamagami, 2001; McArdle, 2009; see Figure 1). We used the specified measurement model to estimate a latent intercept factor (i) and a slope factor (s) as additional latent variables. The latent intercept factor represented interindividual differences in anxiety at the first measurement point, whereas the latent slope factor reflected interindividual differences in intraindividual mean-level changes over two time points.

First, we built a model to test the impact of demographic variables. To this end, we included gender, age (and higher orders of age), and education as covariates to test for general effects on cross-sectional differences and mean-level changes in anxiety. To test for effects of gender and education on age-related influences as well as education on gender differences, we furthermore included interaction terms as covariates. We also stepwise included interaction terms of higher orders of age and gender/education, but we excluded them from our final model because their influence was not significant at  $p < .01$ .

Building on this, we estimated a multivariate latent change model by including mean levels as well as mean-level changes in cognitive functioning (CF), limitations on activities (LoA), physical activity (PA), and autonomy and control (AC) as covariates in our model. In the cases of CF and AC, we first built separate measurement models across the subscores or items and both measurement points in terms of strict factorial invariance (CF/AC: RMSEA = .012/.044, CFI = .998/.947, SRMR = .007/.040) and finally estimated the latent intercept (i) and slope factors (s) simultaneously in one model. In the cases of LoA and PA, we used our 1-item-indicators at t1 and calculated manifest difference scores to reflect changes between t1 and t2. We included these eight scores as additional predictors for the slope in anxiety in our model and also used the intercepts to predict anxiety at t1. We also included interaction terms for the intercepts and slopes and demographic variables but excluded them from our final models if their influences were not significant at  $p < .001$ . Although the complexity of our model prevented us from modelling latent interaction terms, we used an intermediate step to save the factor scores from our latent factors to model manifest interaction terms. Because of the multitude of tested effects, we only interpreted relations at a significance level of  $p < .01$ .

## Results

Appendix table A.1 shows descriptives and correlations for all examined constructs. Overall, these first results indicated that higher levels of anxiety are associated with late adulthood. They also indicated that lower scores in cognitive and physical functioning are associated with higher anxiety and older ages. They furthermore hinted at differences in anxiety by gender and education level.

To examine these associations more comprehensively, we report our results from structural equation modelling in the following sections. We first focus on cross-sectional and longitudinal findings regarding age differences in anxiety during middle and late adulthood. Second, we present associations between anxiety and gender and anxiety and education.

Third, we report results examining the associations with indicators of cognitive and physical functioning. In the description of findings, we report standardized associations.

### **Measurement Model of Anxiety**

In the overall sample, starting at a relatively low level (intercept: mean = 0.54,  $p < .001$ ), anxiety showed a small-sized increase over a period of two years (slope: mean = 0.02,  $p < .001$ ). This increase in anxiety corresponds to 0.03 standard deviations. However, initial anxiety levels and slopes varied statistically significantly between persons indicating further influences on the development of anxiety (see Table 1). To better illustrate the variability of mean-level changes, we calculated the 95% plausible value ranges of the initial level and difference score using the average value and its standard deviation (see Raudenbush & Bryk, 2002). Under the assumption of normally distributed random effects, starting points ranged from -0.43 to 1.59. Individual changes over two years ranged from -0.94 to 0.99 for approximately 95% of our sample.

### **Associations with Age and Gender**

The model 1 column of table 2 shows the associations of age and gender with anxiety trajectories in detail. Our results indicated a small-sized relation with non-linearity in age effects on developmental trajectories of anxiety. Regarding cross-sectional mean-level differences, we found higher initial levels as a function of age in terms of quadratic increases (linear effect:  $b = .13$ ,  $p < .001$ ; quadratic effect:  $b = .06$ ,  $p < .001$ ). Regarding longitudinal changes, the results provided cubic effects (linear effect:  $b = .11$ ,  $p < .001$ ; quadratic effect:  $b = .04$ ,  $p < .001$ ; cubic effect:  $b = -.06$ ,  $p = .004$ ) in anxiety mean-level changes as a function of age, which represented nonlinear increases in growth across adulthood.

We found a small- to medium-sized relation between gender and anxiety at t1 ( $b = .16, p < .001$ ), indicating higher anxiety in women than in men.<sup>5</sup> However, the results showed no gender differences in mean-level changes in anxiety ( $b = .01, p = .301$ ). We also found an interaction effect between age and gender on the mean level in anxiety ( $b = .05, p = .001$ ), indicating higher levels of anxiety in older women than in older men.

### **Associations with Education**

The model 2 column of table 2 presents results on associations between anxiety and education. Education had a small- to medium-sized main effect on anxiety at t1 ( $b = -.29, p < .001$ ), indicating lower levels of anxiety in individuals with more education. We also found a negative association between education and the intercept of anxiety as a function of gender ( $b = -.15, p < .001$ ), which was statistically modeled as an interaction between gender and education and represented less unfavorable effects of lower education for women than for men. Education showed no effect on mean-level changes in anxiety over two years and no influences on age-specific trajectories.

### **LOESS Curves**

To better explore the nonlinear age effects found in latent change models, we estimated local regressions using LOESS curves. We used standardized intercept and slope scores resulting from latent difference score analyses. The curves are presented in Figure 2 and show the plotted age differences in mean levels and mean-level changes of anxiety across adulthood by gender (labeled 1A and 1B) and education (labeled 2A and 2B). The graphics that plot the intercept against age (1A and 2A) therefore show cross-sectional age-differences in anxiety while the graphics that plot the slope against anxiety (2A and 2B) represent age-differences in longitudinal mean-level changes in anxiety.

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<sup>5</sup> The cross-sectional gender difference equated to  $d = 0.28$ .

Confirming the results of the latent difference score model, the curves showed increases in anxiety across adulthood. Referring to the cross-sectional analyses (1A), anxiety levels seemed to be relatively stable to the age of approximately 70 and showed considerable and continual increases afterwards. According to latent difference score models, the LOESS curves showed age-stable gender differences (i.e., higher anxiety levels in females, see 1A) and educational effects (i.e., lower anxiety scores in people with more education, see 2A). However, we found no differences in developmental trajectories across adulthood as a function of gender or education.

Figure 2, graphs 1B and 2B show age differences in the longitudinal anxiety mean-level changes separately for gender and educational levels. The longitudinal results mostly matched the cross-sectional findings. The curve addressing age differences in longitudinal changes (see 1B) also showed almost no mean-level changes in anxiety between the ages of 50 and 70, and it showed increases in intraindividual mean-level changes after this point. The curve moreover suggested that this increase in change was more pronounced between the ages of 70 and 75 and decelerated beyond 75. Changes in men and women, as well as in less and more educated individuals, were approximately the same.

### **Associations with Cognitive and Physical Functioning**

Finally, we analyzed associations between the intercept and slope of anxiety with intercepts and slopes of cognitive functioning (CF), limitations on activities (LoA), physical activity (PA), and autonomy and control (AC). The results are presented in the model 3 column of table 2. In sum, our indicators were able to explain a substantial proportion of the variance in mean levels ( $R^2 = .503, p < .001$ ) and mean-level changes ( $R^2 = .243, p < .001$ ) in anxiety in middle-aged and older adults. In line with our assumptions, we found losses in functioning substantially connected to anxiety. In focusing on cross-sectional associations, we found higher LoA slightly associated with higher levels of anxiety ( $b = .052, p < .001$ ) and

small- to medium-sized higher anxiety levels in people with lower CF ( $b = -.162, p < .001$ ). In the same manner, lower levels of AC were strongly associated with higher anxiety ( $b = -.592, p < .001$ ), with stronger connections in women ( $b = -.053, p < .001$ ) and less educated individuals ( $b = .066, p < .001$ ). We found no association between PA and anxiety ( $b = -.002, p = .791$ ). Most interestingly, after controlling for the abovementioned associations, we no longer found evidence for increases in anxiety in late adulthood. On the contrary, the results showed a small-sized linear decrease in anxiety over the course of middle and late adulthood in our sample ( $b = -.117, p < .001$ ).

Regarding longitudinal associations, we found limitations on activities at t1 slightly associated with subsequent increases in anxiety ( $b = .034, p = .007$ ) and a marginal prospective effect of lower physical activity ( $b = -.026, p = .034$ ), but we found no associations between the level of CF or AC at t1 and subsequent changes in anxiety (see table 2). However, our results revealed correlated changes between indicators of functioning and anxiety. Longitudinal increases in LoA ( $b = .034, p = .007$ ) were slightly related to increases in anxiety. Our findings also revealed small-sized correlated changes between anxiety and CF ( $b = -.135, p < .001$ ) that were stronger in less educated respondents ( $b = .056, p < .001$ ). We moreover found medium- to strong-sized associations between decreases in AC and increases in anxiety ( $b = -.400, p < .001$ ) that were stronger in women ( $b = -.078, p < .001$ ) and in less educated respondents ( $b = .045, p = .001$ ). Our results also revealed a marginal association between decreases in PA and increases in anxiety ( $b = -.041, p = .041$ ). In line with the cross-sectional results, the positive associations between age and changes in anxiety did not remain statistically significant after controlling for associations with gender, education, and cognitive and physical functioning.

## Discussion

In this study, we sought to examine age differences in levels of anxiety and changes in anxiety in European individuals in middle and late adulthood. To this end, we considered effects of gender, education, and changes in physical and cognitive functioning. This investigation is the first to use a representative longitudinal study with a large sample of respondents in middle and late adulthood from twelve European countries to investigate age and anxiety.

### Anxiety and Age

Regarding age-associated changes in anxiety, our study showed non-linear increases from age 45 to age 90. The cross-sectional and longitudinal findings matched nicely and were in line with our hypotheses: We found anxiety to be relatively stable over the course of middle adulthood followed by subsequent increases in anxiety during late adulthood (starting around age 70). These findings are in line with life span theory (e.g., Baltes & Baltes, 1990), which proposes losses in biological, psychological, and social domains in late adulthood, and with cognitive models (e.g., Beck et al., 1985) that suggest that these losses can promote anxiety. Moreover, our results are mostly comparable with previous findings. Teachman (2006) also found increases in anxiety that started around the age of 75 years in a cross-sectional US sample. De Beurs and colleagues (Beurs et al., 2000) also reported a slight increase in anxiety in Dutch older people over a period of three years. However, our results are contrary to findings from epidemiological studies (e.g., Blay & Marinho, 2012) that commonly indicated lower prevalence of clinically relevant anxiety disorders in late adulthood.

These findings emphasized that anxiety is a major concern in older adults. Although age-related changes were small-sized within a two-year-interval, they accumulated to considerable increases in anxiety over the course of late adulthood (as depicted in Figure 2).



Since previous research has confirmed the major impact of anxiety on individual quality of life (e.g., Wetherell et al., 2001), understanding and preventing anxiety in older adults is a crucial goal with considerable significance for successful aging. Notably, our findings indicated substantial interindividual variability in developmental trajectories of anxiety. Over and above average age-associated increases, some respondents' anxiety showed a more pronounced growth, whereas others' remained constant or even decreased. Building on this, we investigated whether between-person variability in initial level and mean-level changes in anxiety is associated with demographic variables.

### **Anxiety, Gender, and Education**

In line with previous research (e.g., McLean et al., 2011), we found women and less educated individuals to be more anxious than men and more highly educated individuals with small- to medium-sized effects. Gender differences may be due to gender-specific socialization during early adolescence (McLean & Anderson, 2009). Educational differences may be partly a result of socioeconomic disadvantages for people with higher levels of anxiety and may be partly caused by the presence of more risk factors for anxiety in people with less education (Mossakowski, 2014). However, we only found cross-sectional differences; we found no evidence that gender and education also influence the development of anxiety from middle to late adulthood. This result supports the assumption that gender primarily manifests its influence on anxiety in earlier ages (McLean & Anderson, 2009). It is similarly conceivable that education and anxiety primarily interact between childhood and young adulthood when socioeconomic environments are especially influential and individuals choose their educational and occupational paths. Overall, these results highlight the enduring importance of demographic influences on anxiety by showing that established differences according to gender and education remain stable even in late adulthood and do not converge

as a result of decreasing gender-specific socialization pressure or the absence of occupational environments.

### **Anxiety and Age-associated Losses**

To examine how the consideration of age-associated losses in several life domains can contribute to the understanding of age differences in anxiety, we draw on indicators that match areas of cognitive and physical functioning. As hypothesized, we found that people with more pronounced losses in functioning also experience higher levels of anxiety. More precisely, our results showed cross-sectional associations (i.e., relations between higher levels of anxiety at t1 and lower levels of functioning at t1) as well as correlated changes (i.e., relations between longitudinal increases in anxiety and longitudinal decreases in functioning). These findings are in line with a wide range of previous research that has confirmed associations between anxiety and cognitive or physical impairment (e.g., Beaudreau & O'Hara, 2008; Lenze et al., 2001) or reduced autonomy (e.g., Persons et al., 1993). However, relations between losses in functioning and anxiety varied considerably between areas of functioning indicating that different kinds of losses may vary in their threat-related impact. We found small-sized associations with measures of physical functioning, small- to medium-sized associations with cognitive functioning, and large associations with perceptions of autonomy and control. This may highlight the particular importance of individual perceptions of limitations compared to objective losses in functioning as indicated by cognitive models of anxiety (Beck et al., 1985).

The present study also provided evidence that the abovementioned associations play a major role in explaining age differences in anxiety. After taking into account age-associated losses in functioning and their associations with anxiety, we no longer found increases in anxiety in late adulthood. These findings are in line with life span theory (e.g., Baltes & Baltes, 1990), which includes age-associated losses in functioning; these findings also

support the prediction of cognitive models of anxiety (e.g., Beck et al., 1985) that losses in functioning are associated with increases in anxiety. To our knowledge, this is the first study to show that decreases in functioning mediate the association between anxiety and age, and it therefore makes a meaningful contribution to the current knowledge of why anxiety increases in late adulthood.

However, this study leaves open the question of why anxiety increases as a function of losses in physical and cognitive functioning. Our results provided only slight evidence for mutual causal relations and therefore could not replicate previous findings that indicated effects of physical and cognitive impairment on anxiety (see Beaudreau & O'Hara, 2008; Beurs et al., 2000). Our findings also could not support considerations of Beck's cognitive model (Beck et al., 1985) that suggests that higher levels of impairment should reinforce concerns and dysfunctional cognitions and encourage the manifestation of anxiety. However, our analyses also provided only slight evidence for the reversed relation that anxiety causes changes in functioning (as indicated by no or small residual correlations). One possible explanation for why we nevertheless found cross-sectional associations and correlated changes could be that the longitudinal association between functioning and anxiety may also be non-linear, and losses in functioning may be threatening only when they reach critical values. Another possible explanation is the influence of third variables. Even though we controlled for joint relations with gender, education, and age, joint associations with other influences are conceivable (e.g., genetic influences, severe illnesses, considerable changes in living conditions).

Moreover, our cross-sectional—but not our longitudinal—results indicated that anxiety actually decreases in late adulthood after controlling for the influence of gender, education, and decreases in functioning. There are several possible explanations for this effect. On the one hand, it can be seen as support for the assumptions of SST, namely that older people have

better emotion-regulation strategies and therefore experience lower levels of anxiety (especially after controlling for the increasing number of threats). On the other hand, and more probably, lower levels of anxiety in older people could reflect a cohort effect as indicated by Twenge (2000), who conducted two meta-analyses to show that anxiety increased over the last half of the twentieth century. However, although our longitudinal analyses showed no age differences in anxiety after accounting for age-associated losses, this result can be interpreted in favor of SST. We only considered a part of the losses that are commonly expected in late adulthood, and the consideration of a broader range of age-associated threats (e.g., the death of a spouse, chronic illnesses, retirement, or reduced social engagement) may reveal the proposed decrease in anxiety.

### **Anxiety and Age across European Nations**

Findings from additional analyses<sup>6</sup> indicated that our results hold for the different European countries considered in the study. Although these results did not rule out the possibility of meaningful differences for specific relations or specific countries, they favor a considerable level of replicability and generalizability of the observed effects for a variety of European countries.

However, we found national differences in anxiety mean levels that may be attributable to a variety of country-specific influences (e.g., national economic situation, retirement arrangements, social system). This result is also in line with previous studies that indicated cross-national differences in prevalence rates of anxiety disorders in adulthood (WHO, 2000; McDowell et al., 2014).

### **Limitations and Future Directions**

This study had many advantages compared with previous research: the large non-clinical sample size including people of twelve nationalities in Europe with different genders

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<sup>6</sup> Please see the Appendix for specific information about methods and results.

and educational backgrounds, the large age range across 45 years, the longitudinal design, and the use of latent structural equation modelling. Some limitations of this study should also be noted.

We used a longitudinal design with two measurement points over a relatively short time span of two years. Other studies should use more measurement points and longer time spans to investigate intraindividual changes. For example, it may be that the abovementioned cohort effects (as indicated by Twenge, 2000) may do more than simply challenge the comparison of cross-sectional mean levels across age groups; we cannot rule out that cohort-specificity in mean levels influence further developmental processes and therefore also compromise the comparison of intraindividual changes across age groups. In a similar manner, we cannot rule out selection effects as a consequence of higher mortality in people with higher levels of anxiety.

Another limitation lies in the operationalization of our constructs. Some researchers have criticized the Beck Anxiety Inventory for its emphasis on somatic symptoms, arguing that the somatic items may measure medical comorbidity rather than anxiety symptoms in older adults (Wetherell & Gaz, 2005). Additional analyses that used only the cognitive items largely replicated our findings. Two exceptions must be mentioned: First, we found only a slight quadratic cross-sectional association between age and anxiety. However, and most importantly, the cubic longitudinal association between age and anxiety remained stable. Second, we no longer found associations between limitations on activities and anxiety. This result may indicate that age-associated losses in physical functioning are associated with somatic anxiety symptoms but may not influence cognitive components of anxiety.

An additional limitation in the operationalization is that we used self-reports to measure physical functioning. Relations between these constructs and anxiety may be, in part, a result of individual response tendencies. Future research should use a broader range of

constructs to operationalize losses in physical functioning, including objective data.

Furthermore, late adulthood is associated with losses in several domains that future studies should address (e.g., the impact of major life events like the death of a spouse or retirement).

Finally, we included the changes in functioning and psychosocial constructs as predictors for increases in anxiety in our analyses. We favored this procedure because it allowed us to better understand how the relation between age and anxiety changes by accounting for age-associated losses. However, the change for each of the constructs was measured concurrently, and their associations represented correlated changes rather than time-ordered relations. Moreover, the design of our study did not allow us to address in detail the psychological processes that cause this relation. Future research should examine the mechanisms that underlie this relationship.

## **Conclusion**

This study revealed several important and generalizable findings that contribute to the understanding of anxiety in late adulthood. Though previous research has indicated that anxiety and anxiety disorders are less frequent in late adulthood, this study showed that, starting around the age of 70, anxiety increased continuously, and these increases seemed to accelerate with age. Given that life expectancy is rising, these findings emphasize the importance of understanding and preventing anxiety in late adulthood. Gender and education had a meaningful impact on anxiety; women were more anxious than men, and less educated individuals more anxious than more highly educated individuals. Differences according to gender and education remained stable over the considered age range, highlighting the persisting influence of demographic influences on anxiety. The present study also provided evidence that age-associated losses in physical, cognitive, and psychosocial functioning play a major role in our understanding of why anxiety increases in late adulthood. Since we did

not find a causal impact of physical or cognitive functioning on anxiety, more research is needed to address this important issue.

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## Tables

Table 1

Latent Initial Level and Latent Slope for the Development of Anxiety across 2 Years.

Parameters	Unstandardized						Standardized
	Intercept			Slope			Slope
	<i>coef.</i>	<i>SE</i>	<i>p</i>	<i>coef.</i>	<i>SE</i>	<i>p</i>	<i>d</i>
Means	0.54	.005	<.001	0.02	.004	<.001	0.03
Variance	0.27	.007	<.001	0.23	.007	<.001	0.86
<i>Model fit indices</i>							
CFI	.965						
RMSEA	.033						
SRMR	.026						

*Note.* CFI: Comparative Fit Index; RMSEA: Root Mean Square Error of Approximation; SRMR: Standardized Root Mean Square Residual.

Table 2

Effects of Age, Gender, Education, and Cognitive and Physical Functioning on the Mean Level (Intercept) and Mean-Level Change (Slope) of Anxiety.

Variable	Model 1						Model 2						Model 3					
	Intercept			Slope			Intercept			Slope			Intercept			Slope		
	<i>b</i>	<i>SE</i>	<i>p</i>	<i>b</i>	<i>SE</i>	<i>p</i>	<i>b</i>	<i>SE</i>	<i>p</i>	<i>b</i>	<i>SE</i>	<i>p</i>	<i>b</i>	<i>SE</i>	<i>p</i>	<i>b</i>	<i>SE</i>	<i>p</i>
<i>Demographic Variables</i>																		
Gender (0 = male, 1 = female)	.158	.006	<.001	-.008	.007	.301	.233	.016	<.001	.006	.018	.755	.130	.016	<.001	.058	.026	.027
Age	.133	.021	<.001	.112	.024	<.001	.044	.027	.092	.122	.031	<.001	-.117	.022	<.001	.011	.027	.683
Age <sup>2</sup>	.062	.009	<.001	.039	.010	<.001	.052	.009	<.001	.036	.010	<.001	.014	.008	.081	.006	.010	.529
Age <sup>3</sup>	.007	.017	.666	-.056	.019	.004	.020	.017	.233	-.058	.020	.003	-.004	.015	.771	-.034	.019	.077
Gender*Age	.050	.014	.001	.018	.017	.285	.006	.015	.666	.009	.017	.595	-.004	.007	.563	-.002	.009	.848
Education							-.285	.016	<.001	-.025	.018	.176	-.003	.010	.731	.003	.012	.814
Education*Age							-.006	.017	.730	-.022	.019	.248	.054	.015	<.001	.011	.020	.593
Education*Gender							-.146	.020	<.001	-.020	.024	.393	-.021	.016	.171	-.043	.023	.064
<i>Cognitive/Physical Functioning</i>																		
Intercept CF													-.162	.015	<.001	-.011	.017	.520
Intercept LoA													.052	.009	<.001	.034	.013	.007
Intercept PA													-.002	.007	.791	-.026	.012	.034
Intercept AC													-.592	.015	<.001	.002	.015	.890
Intercept AC*Gender													-.053	.007	<.001	.001	.010	.906
Intercept AC*Education													.066	.008	<.001	-.009	.010	.378
Slope CF													-.034 <sub>1</sub>	.021	.098	-.135	.021	<.001
Slope CF*Education													-.010 <sub>1</sub>	.010	.308	.056	.013	<.001
Slope LoA													.036 <sub>1</sub>	.008	<.001	.056	.011	<.001
Slope PA													-.001 <sub>1</sub>	.009	.905	-.041	.020	.041
Slope AC													-.060 <sub>1</sub>	.015	<.001	-.400	.018	<.001
Slope AC*Gender													.030 <sub>1</sub>	.012	.010	-.078	.015	<.001
Slope AC*Education													-.008 <sub>1</sub>	.010	.414	.045	.013	.001
<i>R-Square</i>																		
Intercept Anxiety	.043	.003	<.001				.079	.004	<.001				.503	.014	<.001			
Slope Anxiety	.005	.001	<.001				.005	.001	<.001				.243	.019	<.001			
<i>Model fit indices</i>																		

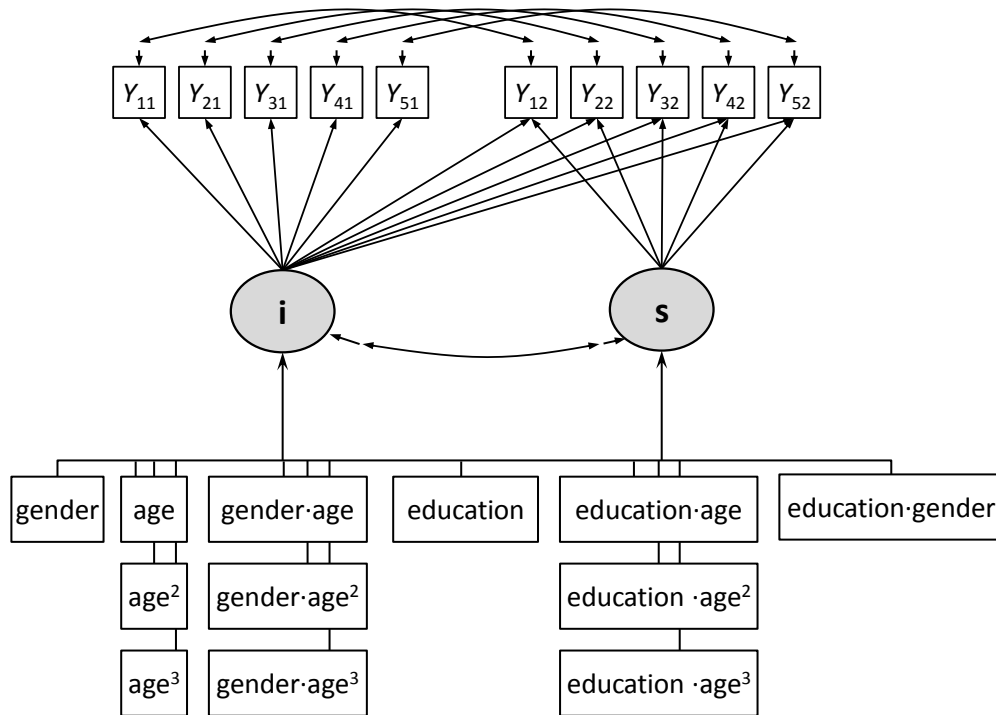
$\chi^2$ (df)	2501.28 (82)	2643.12 (106)	8156.33 (407)
RMSEA	.032	.029	.026
CFI	.948	.948	.926
SRMR	.031	.029	.031

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*Note.* Age and Gender are centered. LoA = Limitations on Activities; CF = Cognitive Functioning; PA = Physical Activity, AC = Autonomy and Control;  $\gamma_1$  = Residual Correlations; CFI:

Comparative Fit Index; RMSEA: Root Mean Square Error of Approximation; SRMR: Standardized Root Mean Square Residual; df = degrees of freedom.

### Figures



*Figure 1.* Latent difference score model analyzing mean-level differences in anxiety. The latent intercept ( $i$ ) reflects cross-sectional mean-level differences. The latent slope ( $s$ ) reflects longitudinal mean-level changes. Gender, education, and age (and higher orders of age) are included as covariates to test for general effects on cross-sectional differences and mean-level changes. To test for effects of gender and education on age-related influences as well as education on gender differences, we furthermore include interaction terms as covariates.

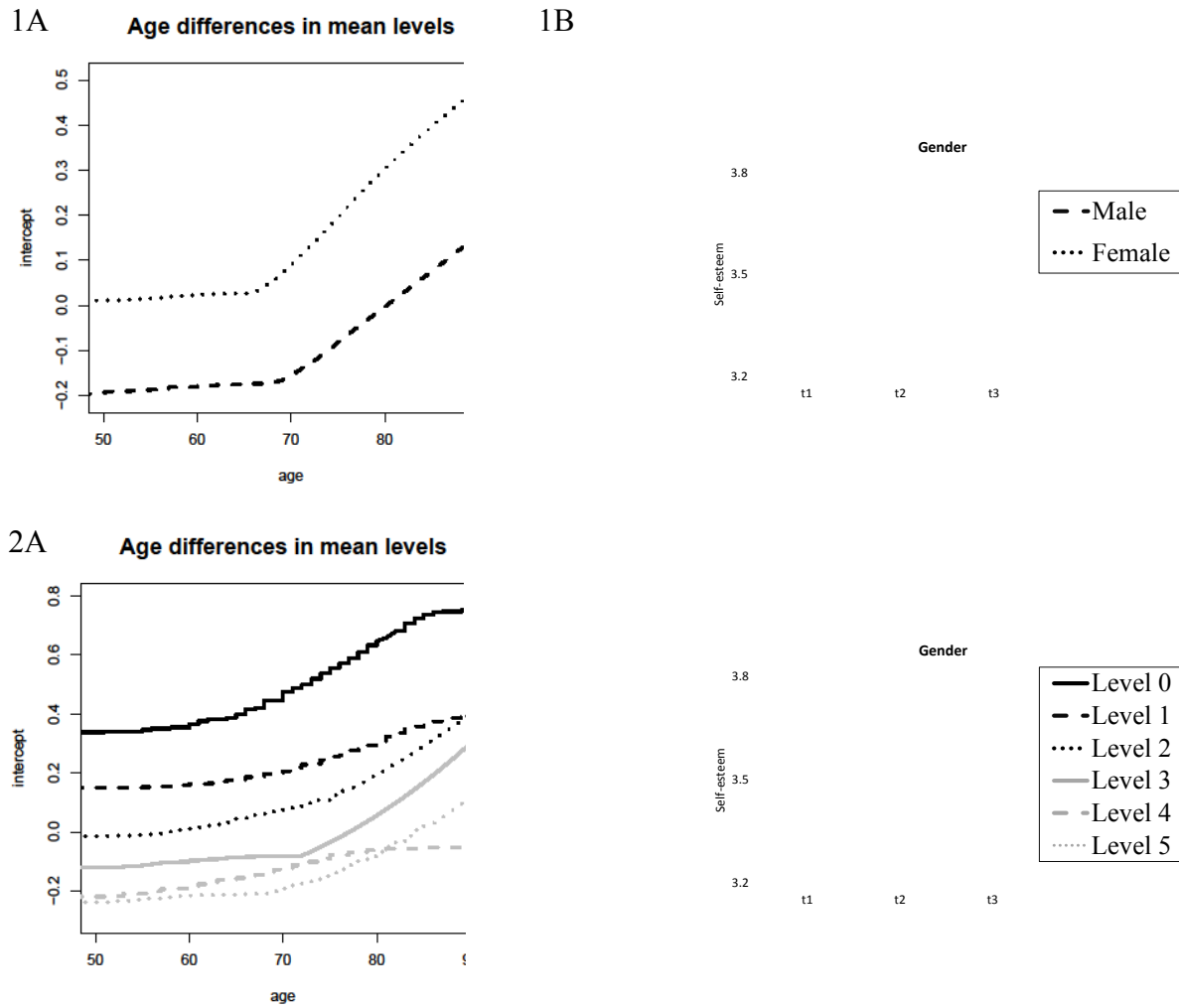


Figure 2. LOESS curves for age difi

gender (1A and 1B) and education (2A and 2B). Values are standardized relative to the first measurement (the intercept is set to 0, and the variance is set to 1). Level 0 = pre-primary education, Level 1 = primary education, Level 2 = secondary education first stage, Level 3 = upper secondary education, Level 4 = post-secondary non-tertiary education, Level 5 = combined the original level 5 and 6 due to small sample sizes and represents the first and second stages of tertiary education.

## Appendix

### Anxiety and Age across European Nations

Since we used a large representative sample from twelve European countries, an important question concerns whether the reported overall effects hold for different European nations. Although we avoid making specific hypotheses regarding cross-national differences in associations, it is commonly known that environmental influences on several levels influence psychosocial processes in humans (cf. Bronfenbrenner, 1979). We computed a set of additional analyses to investigate whether and how developmental trajectories of anxiety and their associations with age, gender, education, and cognitive and physical functioning vary between different European countries. We had to exclude the Czech Republic from these analyses because the items regarding cognitive functioning were not included for this subsample.

As a foundation, we confirmed the cross-national comparability of the anxiety measurement by estimating multiple-group latent change models with eleven groups, assuming strong factorial invariance (RMSEA: .044, CFI: .927, SRMR: .057). We then stepwise remodeled our final analyses using multiple groups. For each step, we compared a model that allowed parameter estimations to vary between nations with a more restrictive model that forced them to be equal. First, we tested whether mean levels and slopes of anxiety vary between nations. We found the best fit for the model that restricted the slopes to be equal but allowed mean levels to vary across nations (as indicated by the lowest BIC; see table S.1 in the supplemental material). More specific information regarding cross-national differences are presented in table S.2 in the supplemental material.

Most importantly, we stepwise tested whether the associations of demographic variables and cognitive and physical functioning with anxiety hold across the different nations (cf. table 2, model 1-3). To reduce the complexity, we modelled anxiety on a latent

level but included manifest factor scores for cognitive and physical functioning resulting from the overall analyses shown in table 2, model 3. For all three models, the more restrictive models that forced the predictions to be equal showed the better model fit (see table S.1 in the supplemental material), indicating comparability of our results across countries.

Table A.1

*Mean levels, standard deviations, and correlations.*

Construct	<i>M</i>	<i>(SD)</i>	1	2	3	4	5	6	7	8	9	10	11	12
1 Anxiety t1	1.54	0.50	1											
2 Anxiety t2	1.55	0.53	.60***	1										
3 Gender	0.57	0.49	.16***	.15***	1									
4 Age t1	65.60	9.56	.11***	.16***	-.02***	1								
5 Education	2.81	1.46	-.22***	-.24***	-.09***	-.22***	1							
6 CF t1	20.23	4.90	-.33***	-.34***	.05***	-.48***	.59***	1						
7 CF t2	20.34	5.30	-.31***	-.39***	.04***	-.51***	.57***	.92***	1					
8 LoA t1	0.44	0.50	.32***	.29***	.05***	.18***	-.12***	-.19***	-.20***	1				
9 LoA t2	0.44	0.50	.29***	.36***	.05***	.22***	-.14***	-.24***	-.25***	.47***	1			
10 PA t1	2.42	1.34	-.20***	-.22***	-.10***	-.23***	.19***	.30***	.30***	-.21***	-.20***	1		
11 PA t2	2.37	1.33	-.22***	-.25***	-.09***	-.26***	.19***	.30***	.33***	-.21***	-.24***	.46***	1	
12 AC t1	2.94	0.61	-.65***	-.50***	-.08***	-.16***	.19***	.30***	.30***	-.38***	-.33***	.24***	.25***	1
13 AC t2	2.99	0.62	-.50***	-.64***	-.06***	-.21***	.21***	.32***	.36***	-.34***	-.40***	.25***	.28***	.71***

*Note.* Gender: 0 = male, 1 = female; LoA = Limitations on Activities; CF = Cognitive Functioning; PA = Physical Activity, AC = Autonomy and Control, \*\*\*  $p < .001$ .